UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

OFFICE OF
RESEARCH AND DEVELOPMENT

MEMORANDUM

SUBJECT: Congener-specific PCB analyses on New Bedford Harbor Seafood

TO: Frank Ciavattieri, Remedial Project Manager
Region I

FROM: Susan Braen Norton, Environmental Scientist
Exposure Assessment Group SBN

Staff of the Exposure Assessment Group and the Narragansett Laboratory have completed the analysis of the congener-specific PCB analyses on lobsters and flounders collected from New Bedford Harbor. The objective of the analysis was to provide insight into how best to characterize the risk associated with ingesting seafood from New Bedford Harbor. Specifically, the issue is whether there is sufficient evidence to support using a cancer potency factor other than the most recent PCB potency factor that is based on Aroclor 1260. The analyses, results, and conclusions of our effort are described in this memo.

Staff of the Narragansett Laboratory and Science Applications International Corporation (SAIC) chemically analyzed five flounders, five lobsters, and samples of the commercial mixtures Aroclor 1016, 1242, 1254, and 1260. The five flounders were collected by the Narragansett laboratory from inside the hurricane barrier, and the five lobsters were collected from Area 3 by the Massachusetts Division of Marine Fisheries. Flounder flesh, lobster flesh, and lobster hepatopancreas were included in the study. After extracting the tissues with acetone, PCB congeners were separated and quantified using capillary gas chromatography and an electron capture detector. By using three columns, the Narragansett Laboratory was able to quantify a suite of 51 separate congeners.

The data were statistically analyzed using principal components analysis (via the SIMCA software package). Principal components analysis is a very useful technique that simplifies large matrices of data (51 congeners by 21 samples in this case) to a series of independent "principal components" that best explain the variation in the data. By plotting the principal components, similarities in the patterns of congeners in the samples can be more easily identified. In addition, class models (e.g., for lobster samples) can be constructed and used to test

how close other samples (e.g., Aroclor 1260) are to the class. Finally, by examining how each congener influences the principal components, we can begin to understand how PCB patterns change in the environment.

The analyses of the New Bedford Harbor data consisted of three steps; construction of class models, plotting of principal components, and analysis of specific congeners. First, I constructed class models (using the PARC subroutine in the SIMCA statistical package) for the lobster flesh, lobster hepatopancreas and flounder. Then I tested how close the commercial mixtures came to fitting the models. The results of the classification are shown in Table 1. As can be seen, Aroclor 1254 had the lowest deviation from the class models, with Aroclor 1260 running a close second. Even these two mixtures, however, were greater than 5 standard deviations away from any of the classes.

In the second step, I took another look at the relationship between the samples and Aroclors 1260 and 1254 by plotting principal components. Figures 1, 2, and 3 show the principal components plots for each type of seafood plus Aroclors 1254 and 1260. As expected from the classification step, the biota samples aren't very close to either Aroclor. However, the principal components plot shows that patterns of PCBs in the seafood samples lie roughly in between the two commercial mixtures and are just about equidistant from both.

To gain some insight into how the seafood differs from the commercial mixture, I investigated which specific congeners were present in greater amounts in the seafood than in 1254 and 1260. I divided the fractions of each congener in the seafood by the corresponding fractions in 1254 and 1260 to obtain "enrichment factors". Some of the larger enrichment factors are shown in Figures 4 and 5. Of particular interest is that fractions of some non and mono-ortho substituted congeners (particularly 3,4,5,3',4'-PCB and 3,4,3',4'-TCB) are consistently higher in the seafood compared with the two commercial mixtures. The non-ortho substituted congeners have been shown to induce enzymes in a manner similar to 3-methylcholanthrene and dioxin. Although induction of this enzyme system has not yet been correlated with carcinogenic potency, it has been correlated with other toxic effects, such as thymic atrophy, in experimental animals.

The conclusions of the analyses can be summarized as follows. The PCB mixture in the seafood from New Bedford Harbor cannot be classified as any commercial mixture, although the pattern of PCBs in the seafood appears to lie roughly between Aroclors 1254 and 1260. That the non-ortho substituted congeners are not depleted but are actually enriched in New Bedford Harbor seafood lends some support for taking a conservative approach to assessing risks from seafood ingestion.

TABLE 1

CLASS MODEL ANALYSES

CLASS	Standard Deviations Away From Model			
	A1016	**A1242**	**A1254**	**A1260**
Lobster Flesh	11000	3300	47	67
Lobster Hepato.	22000	6500	37	54
Flounder	1500	500	5.4	9.8

FIGURE 1

PRINCIPAL COMPONENTS PLOT
LOBSTER FLESH

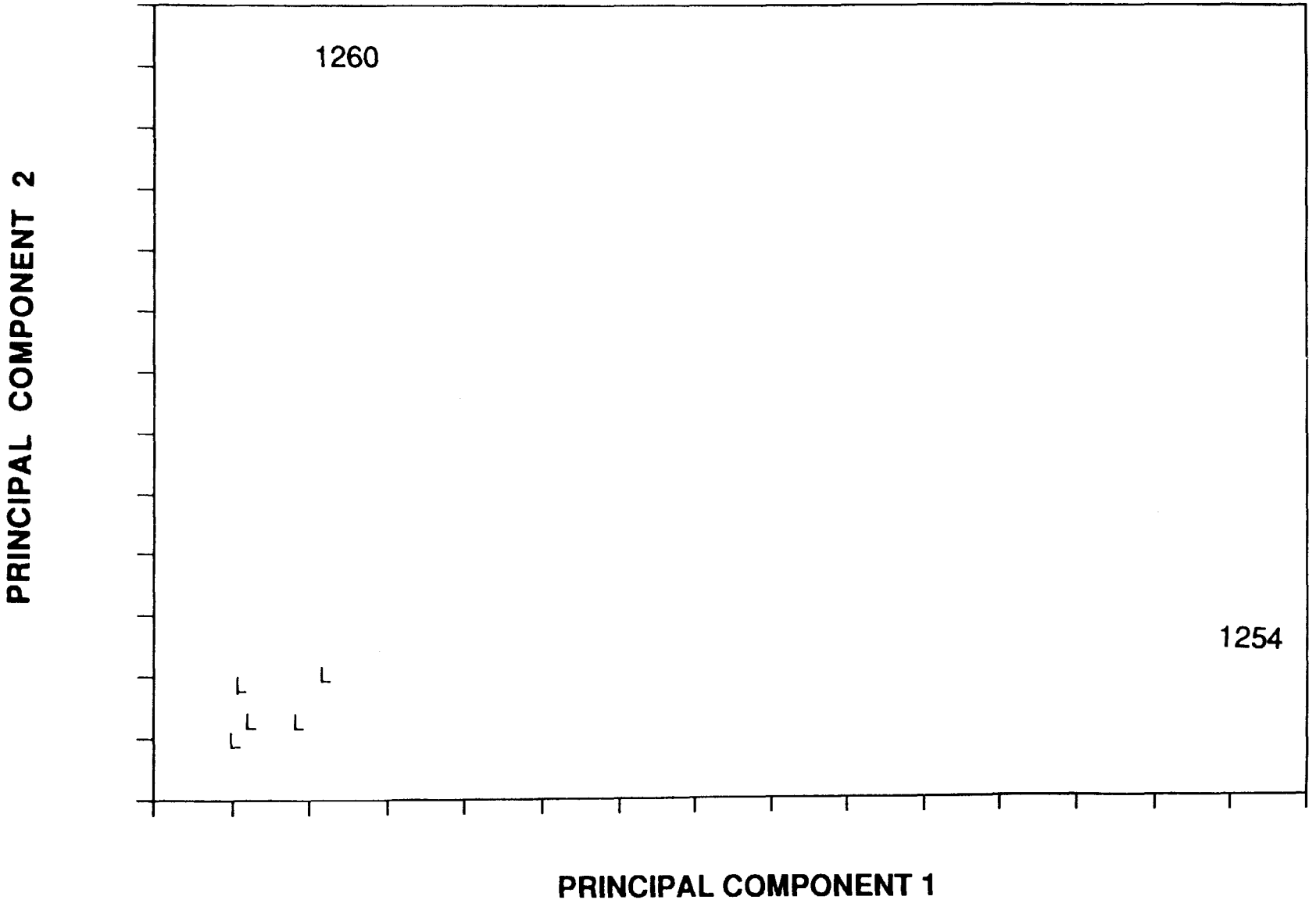


FIGURE 2

PRINCIPAL COMPONENTS PLOT
LOBSTER HEPATOPANCREAS

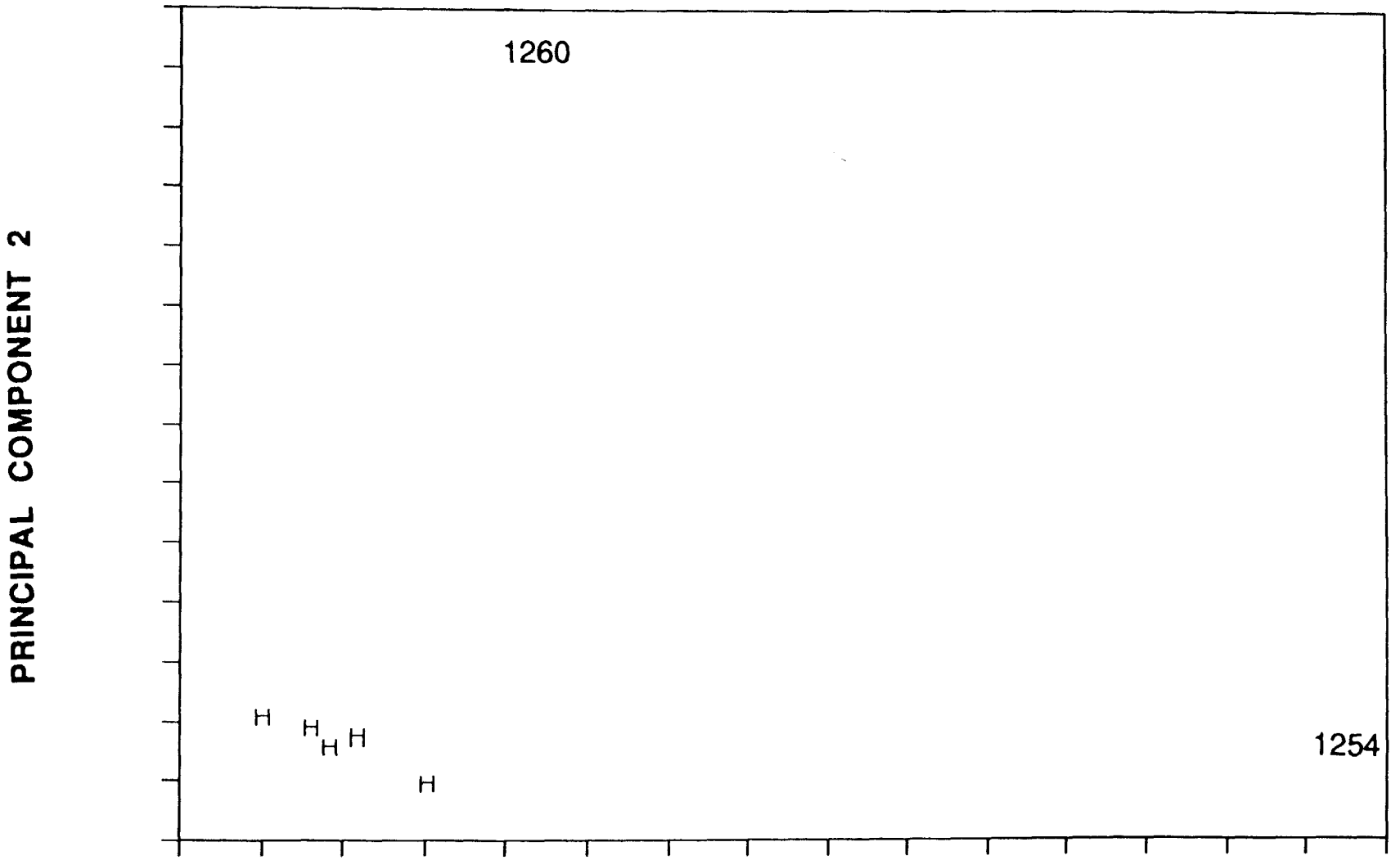


FIGURE 3

PRINCIPAL COMPONENTS PLOT
FLOUNDER FLESH

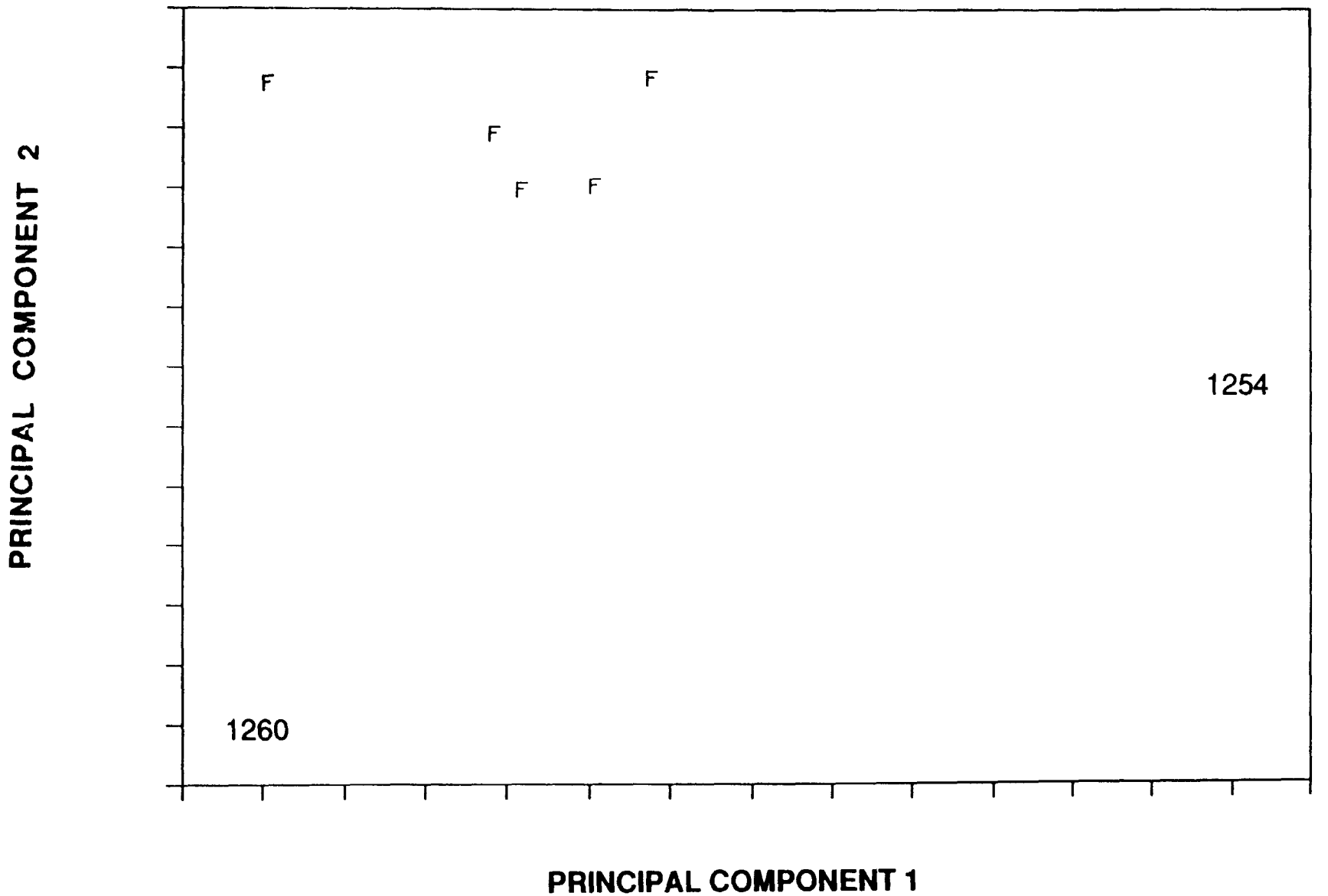


FIGURE 4

ENRICHMENT OF SELECTED CONGENERS

RELATIVE TO AROCLOR 1254

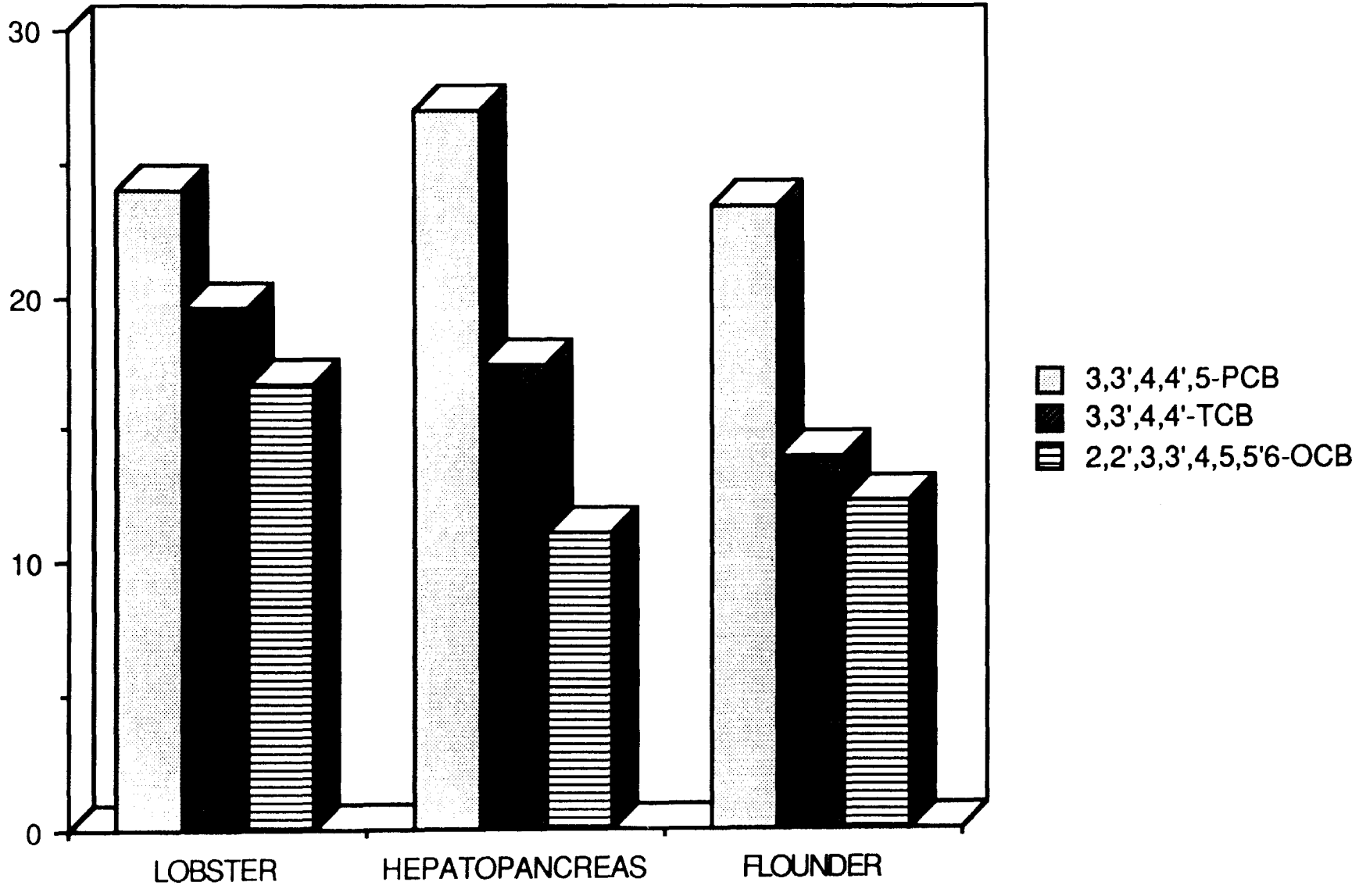
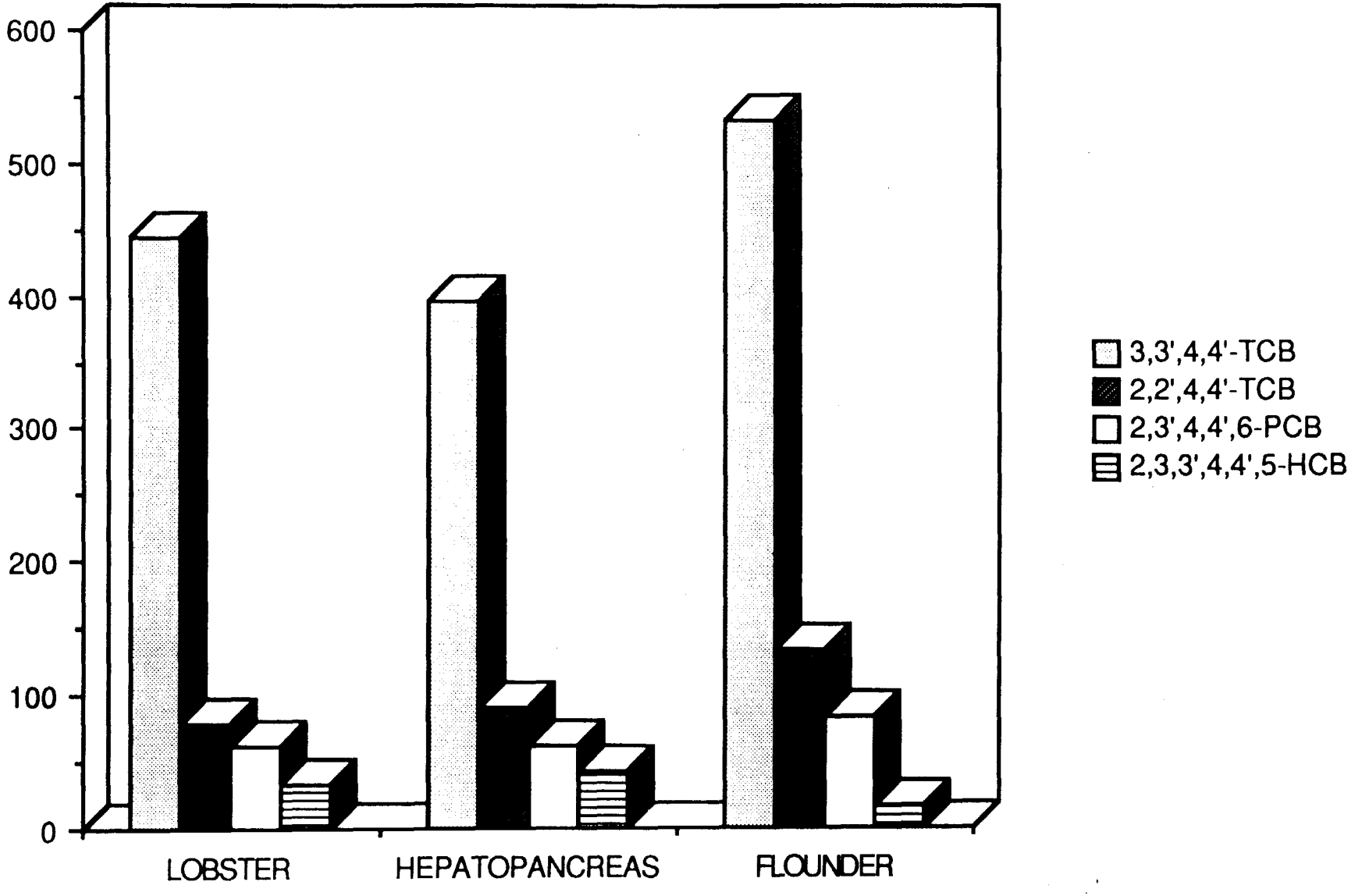


FIGURE 5

ENRICHMENT OF SELECTED CONGENERS

RELATIVE TO AROCLOR 1260



It also should be noted that the non-ortho substituted congeners have not normally been quantified in the past because of difficulties in analytical techniques. The progress that the Narragansett Laboratory has made in separating and quantifying the non-ortho substituted congeners contributed significantly to the findings of the current effort.

I discussed the results of the analysis with Jim Cogliano of the Carcinogen Assessment Statistics and Epidemiology Branch (formerly CAG). CAG's current cancer potency factor for PCBs ($7.7\ (mg/kg/d)^{-1}$) is based on the Norback and Weltman (1985) bioassay using rats. This bioassay has a stronger experimental design than either the 1975 Aroclor 1260 bioassay or the NCI Aroclor 1254 bioassay. Hence, the 1985 bioassay currently provides the best estimate of cancer potency for any PCB mixture. Because, as described above, the PCB mixture in seafood does not closely resemble any commercial PCB product, there are uncertainties in using any commercial product to estimate the potency of the mixture in seafood. Since the potency factor for Aroclor 1260 of $7.7\ (mg/kg/d)^{-1}$ is the most scientifically defensible estimate of PCB potency currently available, I would recommend that it be used to assess risks from ingesting seafood from New Bedford Harbor.

cc: M. Callahan (RD-689)
J. Cogliano (RD-689)
R. McGaughy (RD-689)
W. Farland (RD-689)
E. Ryan (EC Jordan)
S. Levinson (Region I)